

CLAIMS

*SAC* 1. An image processing computer system for a photogrammetric analytical measurement, in which camera parameters necessary for production of a survey map are determined based on a picture having an image of a target, said camera parameters representing a photographing position and a photographing direction of a camera, by which said picture is photographed, the target having at least three main reference point areas and at least one assistant reference point area, each of the reference point areas being formed as a high luminance point area surrounded by a low luminance area, said computer system comprising:

a target-image extractor that extracts the image of said target from said picture based on positional relationships between the main and assistant reference point areas of said target;

an image processor that processes the extracted image of said target to determine a two-dimensional position of each of said main and assistant reference point areas of said target with respect to a two-dimensional picture coordinate system defined on said image;

a first calculator that calculates three-dimensional positions of said main reference point areas with respect to a three-dimensional camera coordinate system defined on said

camera;

a second calculator that calculates two-dimensional positions of said main reference point areas with respect to a two-dimensional image-plane coordinate system, defined on 5 an image-plane of said camera, based on the three-dimensional positions of said main reference point areas calculated by said first calculator; and

a third calculator that calculates camera parameters based on the two-dimensional positions of said main reference 10 point areas with respect to said two-dimensional picture coordinate system and the two-dimensional positions of said main reference point areas with respect to said two-dimensional image-plane coordinate system.

2. An image processing computer system as set forth 15 in claim 1, further comprising:

a fourth calculator that calculates a three-dimensional position of said assistant reference point area with respect to said three-dimensional camera coordinate system based on the camera parameters calculated by said third 20 calculator;

a fifth calculator that calculates a two-dimensional position of said assistant reference point area with respect to said two-dimensional image-plane coordinate system based on the three-dimensional position of said assistant reference 25 point area calculated by said fourth calculator; and

a determiner that determines whether the calculation of the camera parameters by said third calculator is correct or incorrect by comparing the two-dimensional position obtained by said image processor with the two-dimensional 5 position of said assistant reference point area calculated by said fifth calculator.

3. An image processing method for a photogrammetric analytical measurement, in which camera parameters necessary for production of a survey map are determined based on a picture 10 having an image of a target, said camera parameters representing a photographing position and a photographing direction of a camera, by which said picture is photographed, the target having at least three main reference point areas and at least one assistant reference point area, each of the reference point 15 areas being formed as a high luminance point area surrounded by a low luminance area, said method comprising steps of:

extracting the image of said target from said picture based on positional relationships between the main and assistant reference point areas of said target;

20 processing the extracted image of said target to determine a two-dimensional position of each of said main and assistant reference point areas of said target with respect to a two-dimensional picture coordinate system defined on said target;

25 calculating three-dimensional positions of said main

reference point areas with respect to a three-dimensional camera coordinate system defined on said camera;

calculating two-dimensional positions of said main reference point areas with respect to a two-dimensional image-plane coordinate system, defined on an image-plane of said camera, based on the three-dimensional positions of said main reference point areas; and

calculating camera parameters based on the two-dimensional positions of said main reference point areas with 10 respect to said two-dimensional picture coordinate system and the two-dimensional positions of said main reference point areas with respect to said two-dimensional image-plane coordinate system.

4. An image processing method as set forth in claim 15 3, further comprising:

calculating a three-dimensional position of said assistant reference point area with respect to said three-dimensional camera coordinate system based on the calculated camera parameters;

20 calculating a two-dimensional position of said assistant reference point area with respect to said two-dimensional image-plane coordinate system based on the calculated three-dimensional position of said assistant reference point area; and

25 determining whether the calculation of the camera

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parameters is correct or incorrect by comparing the two-dimensional position based on said two-dimensional picture coordinate system with the two-dimensional position of said assistant reference point area based on said two-dimensional 5 image-plane coordinate system.

5. A memory medium storing an image processing program for a photogrammetric analytical measurement, in which camera parameters necessary for production of a survey map are determined based on a picture having an image of a target, said 10 camera parameters representing a photographing position and a photographing direction of a camera, by which said picture is photographed, the target having at least three main reference point areas and at least one assistant reference point area, each of the reference point areas being formed as a high 15 luminance point area surrounded by a low luminance area, said program comprising steps of:

extracting the image of said target from said picture based on positional relationships between the main and assistant reference point areas of said target;

20       processing the extracted image of said target to determine a two-dimensional position of each of said main and assistant reference point areas of said target with respect to a two-dimensional picture coordinate system defined on said target;

25       calculating three-dimensional positions of said main

reference point areas with respect to a three-dimensional camera coordinate system defined on said camera;

calculating two-dimensional positions of said main reference point areas with respect to a two-dimensional 5 image-plane coordinate system, defined on an image-plane of said camera, based on the three-dimensional positions of said main reference point areas; and

calculating camera parameters based on the two-dimensional positions of said main reference point areas with 10 respect to said two-dimensional picture coordinate system and the two-dimensional positions of said main reference point areas with respect to said two-dimensional image-plane coordinate system.

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(all)

6. A memory medium as set forth in claim 5, wherein 15 said program further comprises:

calculating a three-dimensional position of said assistant reference point area with respect to said three-dimensional camera coordinate system based on the calculated camera parameters;

20 calculating a two-dimensional position of said assistant reference point area with respect to said two-dimensional image-plane coordinate system based on the calculated three-dimensional position of said assistant reference point area; and

25 determining whether the calculation of the camera

parameters is correct or incorrect by comparing the two-dimensional position based on said two-dimensional picture coordinate system with the two-dimensional position of said assistant reference point area based on said two-dimensional 5 image-plane coordinate system.

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